WHAT IS CLAIMED:

1. Pump apparatus for pumping a sample to an analyser for analysis, comprising;

a first pump arranged to pump the sample into a buffer region at a first flow rate, and

a second pump arranged subsequently to pump a second fluid into said buffer region at a second flow rate to cause at least a portion of the sample to be displaced from the buffer region to the analyser, said second pump being operable so that the second flow rate is more accurately controllable than the first flow rate.

2. Apparatus according to claim 1, further comprising a mixer disposed downstream of the buffer region and upstream of the analyser on a buffer outlet conduit, said mixer being arranged to mix the sample with a diluent to dilute the sample before analysis.

3. Apparatus according to claim 2, further comprising a third pump arranged to pump the diluted sample to the analyser at a third flow rate.

4. Apparatus according to claim 3, wherein the diluent is pumped into the mixer at a fourth flow rate, said fourth flow rate being substantially the difference between the third and second flow rates.

5. Apparatus according to claim 4, wherein the third pump is arranged to pump the diluent into the mixer.

6. Apparatus according to claim 1, wherein the buffer region is arranged to have a first and second port.

7. Apparatus according to claim 6, wherein the first pump is arranged to dispose the sample into the buffer region via the first port and the second pump is arranged to disposed the second fluid into the buffer region via the second port.

8. Apparatus according to claim 6, further comprising

a flow switching means moveable between a first and second position, the flow switching means being so arranged that;

(a) when the switching means is in the first position, the buffer region is in fluid communication with the first pump, and

(b) when the switching means is in the second position, the first buffer region port is in fluid communication with the mixer, and a second buffer region port is in fluid communication with the second pump.

9. Apparatus according to claim 8, further comprises a waste conduit so arranged that, when the switching means is in the first position, the buffer region is also in fluid communication with the waste conduit.

10. Apparatus according to claim 8, wherein the switching means is arranged so that, when the switching means is in the second position, the waste conduit is in fluid communication with the first pump, the first pump being arranged to pump a flush agent.

11. Apparatus according to claim 8, further comprising,

when the switching means is in the first position, the second pump is in fluid communication with the outlet conduit disposed between the mixer and buffer region, so that the second fluid can be pumped into the outlet conduit for displacement of the sample fluid or second fluid therein.

12. Apparatus according to claim 2, wherein the mixing region comprises two or more input tubes, a mixing portion and an exit tube,

a first input tube being arranged for communicating the sample fluid to the mixing portion from the buffer region, and

a second input tube being arranged for communicating the diluting agent to the mixing portion.

13. Apparatus according to claim 11, further comprising,

when the switching means is in the second position,

the second pump is arranged to pump the sample fluid through the mixing region at the second flow rate, and

the third pump is arranged to pump the diluted sample fluid at a third flow rate.

14. Apparatus according to claim 1, further comprising a controller for monitoring and/or adjusting at least one of the first, second or third pump means, and/or the switching means, during operation.

15. Apparatus according to claim 14, wherein the controller is a PC.

16. Apparatus according to claim 14, wherein the controller is arranged to receive analysis data from the analyser.

17. Apparatus according to claim 16, further comprising when the switching means is in the second position, the second pump is arranged to pump the sample fluid through the mixing region at the second flow rate, and the third pump is arranged to pump the diluted sample fluid at a third flow rate, wherein the third rate is substantially equal to, or greater than, the second rate, and

wherein the controller is arranged to adjust the first and/or third rate in response to received analysis data.

18. Apparatus according to claim 17, wherein the controller is arranged to adjust the flow rates in real time.

19. Apparatus according to claim 1, wherein the analyser is a mass spectrometer, or an inductively coupled plasma mass spectrometer.

20. Apparatus according to claim 1, wherein the second pump means comprise a piston pump.

21. An analyser for analysing a sample fluid, comprising a pumping system according to claim 1.

22. An analyser according to claim 21, wherein the analyser is a mass spectrometer, or an inductively coupled plasma mass spectrometer.

23. A method for pumping a sample fluid for analysis to an analysis instrument using a pumping apparatus comprising,

a buffer region for temporarily storing the sample fluid, the buffer region being arranged with at least two ports,

disposing the sample fluid in the buffer region using a first pump means at a first flow rate through a first port, and

the method comprising,

pumping a second fluid into the at least partially filled buffer region at a second flow rate through a second port, using a second pump means, thereby displacing the sample fluid therein to the analyser,

whereby the second pump means is more accurately controllable than the first pump means.

24. A method according to claim 23, wherein the apparatus further comprises

a flow switching means moveable between a first and second position, the flow switching means being so arranged that;

(a) when the switching means is in the first position, the buffer region is in fluid communication with the first pump, and

(b) when the switching means is in the second position, the first buffer region port is in fluid communication with the mixer, and a second buffer region port is in fluid communication with the second pump.

the method further comprising,

pumping the sample into the buffer when the flow switching means is in the first position using the first pump,

switching the flow switching means to the second position, and

pumping the second fluid into the buffer region using the second pump for displacement of the sample therein.

25. A method according to claim 24, the apparatus further comprising a waste conduit so arranged that, when the switching means is in the first position, a buffer region port is in fluid communication waste conduit,

the method further comprising,

pumping excess fluid in the buffer region to the waste conduit.

26. A method according to claim 25, further comprising,

when the switching means is in the second position, the waste conduit is in fluid communication with the first pump, and the first pump pumps a flush agent.

27. A method according to claim 24, further comprising,

when the switching means is in the first position, the second pump is in fluid communication with the outlet conduit, and

the second pump pumps the second fluid into the outlet conduit for displacement of the sample fluid or second fluid therein.

28. A method according to claim 24, the apparatus further comprising,

a mixing region for mixing the sample fluid with a diluting agent, and

a third pump means pumps diluted sample fluid from the mixing region to the analyser,

wherein, the mixing region is disposed between the outlet conduit and the analyser;

the method further comprising,

when the switching means is in the second position,

the second pump means pumps sample fluid into the buffer region at a second flow rate,

the third pump means pumps the diluted sample fluid at a third flow rate, and

the third pump means pumps the diluting agent at a fourth flow rate substantially equal to the difference of the third and second flow rate.

29. A method according to claim 24, wherein the apparatus further comprises a controller which monitors and/or adjusts at least one of the first, second or third pump means, and/or the switching means.

30. A method according to claim 29, wherein the controller receives analysis data from the analyser.

31. A method according to claim 30, the apparatus further comprising:

a mixing region for mixing the sample fluid with a diluting agent, and

a third pump means pumps diluted sample fluid from the mixing region to the analyser, wherein the mixing region is disposed between the outlet conduit and the analyser;

the method further comprising:

when the switching means is in the second position, the second pump means pumps sample fluid into the buffer region at a second flow rate, the third pump means pumps the diluted sample fluid at a third flow rate, and the third pump means pumps the diluting agent at a fourth flow rate substantially equal to the difference of the third and second flow rate, wherein the third rate is substantially equal to, or greater than, the second rate, and

wherein the controller adjusts the first and/or third rate in response to the received analysis data.

32. A method according to claim 31, wherein the controller adjusts the flow rates in real time.

33. A method according to claim 23, further comprising:

disposing an internal standard into the sample, said internal standard comprising a known concentration of a predetermined substance, and

determining the factor by which the sample is diluted by comparing the detected concentration of the internal standard with the known concentration of the internal standard in the undiluted sample.

34. A method according to claim 33, wherein a second internal standard comprising a known concentration of a second predetermined substance is disposed in the sample and the diluent at the same second concentration levels.

35. A method according to claim 33, further comprising:

determining the dilution factor from the amount of the first internal standard detected by the analyser,

determining a correction factor by comparing the determined dilution factor with an expected dilution factor, and

using the correction factor to correct analyser data.

36. A method for diluting a sample fluid according to claim 23, using pump apparatus, comprising:

a first pump arranged to pump the sample into a buffer region at a first flow rate, and

a second pump arranged subsequently to pump a second fluid into said buffer region at a second flow rate to cause at least a portion of the sample to be displaced from the buffer region to the analyser, said second pump being operable so that the second flow rate is more accurately controllable than the first flow rate.

37. A computer program which, when run on a computer, carries out the method according to claim 36.

38. An electronic carrier means on which is stored the computer program according to claim 37.

39. A method of preventing contamination of a first pump means with a sample, the method comprising;

disposing the sample in an intermediary region using a second pump,

displacing the sample from the intermediary region by pumping a second fluid into said intermediary region using the first pump means.

40. A method according to claim 39, further comprising:

disposing an internal standard into the sample, said internal standard comprising a known concentration of a predetermined substance, and

determining the factor by which the sample is diluted by comparing the detected concentration of the internal standard with the known concentration of the internal standard in the undiluted sample.

41. A method according to claim 40, wherein a second internal standard comprising a known concentration of a second predetermined substance is disposed in the sample and the diluent at the same second concentration levels.

42. A method according to claim 40, further comprising:

determining the dilution factor from the amount of the first internal standard detected by an analyser,

determining a correction factor by comparing the determined dilution factor with an expected dilution factor, and

using the correction factor to correct analyser data.

43. A diluting system for diluting a sample fluid for analysis, comprising;

a buffer region for storing the sample fluid arranged with an input and output,

a first pump means for pumping the sample fluid into a sample fluid buffer region through the input,

a second pump means for pumping a second fluid into the buffer region through the output,

an outlet conduit arranged for flow of the sample fluid and/or fluid to the analyser

a mixing region for mixing the sample fluid with a diluting agent,

a third pump means for pumping diluted sample fluid from the mixing region to the analyser, and

a flow switching means moveable between a first and second position, so arranged that,

when the switching means is in the first position, the buffer region input is in communication with the first pump and the sample fluid can be pumped into the buffer region, and

when the switching means is in the second position, the buffer region input is in communication with the outlet conduit, and the buffer region output is in communication with the second pump so that the second fluid can be pumped into the buffer region for displacement of the sample fluid therein, and wherein, the mixing region is disposed between the outlet conduit and the analyser.

44. A method according to claim 43, further comprising:

disposing an internal standard into the sample, said internal standard comprising a known concentration of a predetermined substance, and

determining the factor by which the sample is diluted by comparing the detected concentration of the internal standard with the known concentration of the internal standard in the undiluted sample.

45. A method according to claim 44, wherein a second internal standard comprising a known concentration of a second predetermined substance is disposed in the sample and the diluent at the same second concentration levels.

46. A method according to claim 44, further comprising:

determining the dilution factor from the amount of the first internal standard detected by the analyser,

determining a correction factor by comparing the determined dilution factor with an expected dilution factor, and

using the correction factor to correct analyser data.

47. A method for diluting a sample fluid for analysis using a dilution system comprising,

a buffer region for storing the sample fluid arranged with an input and output,

an outlet conduit arranged for flow of the sample fluid and/or the second fluid to the analyser,

a mixing region for mixing the sample fluid with a diluting agent, and

a third pump means arranged to pump diluted sample fluid from the mixing region to the analyser, the mixing region is disposed between the outlet conduit and the analyser, and

a flow switching means moveable between a first and second position, so arranged that, when the switching means is in the first position, the buffer region input is in communication with a first pump, and when the switching means is in the second position, the buffer region input is in communication with the outlet conduit, and the buffer region output is in communication with a second pump;

the method comprising,

pumping the sample fluid into the sample fluid buffer region through the input when the switching means is in the first position, using the first pump means,

switching the switching means to the second position,

pumping a fluid into the buffer region through the output, thereby displacing the sample fluid therein to the outlet conduit,

when the switching means is in the second position, the second pump means pumps the second fluid into the buffer region at a first flow rate, such that the sample fluid proceeds through the mixing region at the first flow rate,

the third pump means pumps the diluted sample fluid at a third flow rate, and

the third pump means pumps the diluting agent at a second flow rate substantially equal to the difference of the third and first flow rate.

48. A method according to claim 47, further comprising:

disposing an internal standard into the sample, said internal standard comprising a known concentration of a predetermined substance, and

determining the factor by which the sample is diluted by comparing the detected concentration of the internal standard with the known concentration of the internal standard in the undiluted sample.

49. A method according to claim 48, wherein a second internal standard comprising a known concentration of a second predetermined substance is disposed in the sample and the diluent at the same second concentration levels.

50. A method according to claim 48, further comprising:

determining the dilution factor from the amount of the first internal standard detected by the analyser,

determining a correction factor by comparing the determined dilution factor with an expected dilution factor, and

using the correction factor to correct analyser data.

51. A method of pumping a fluid sample through a dilutor using a first pump, for analysis of the diluted fluid sample downstream of said dilutor, said first pump being isolated from said fluid sample, the method comprising:

disposing said fluid sample in an intermediary region using a second pump, said intermediary region having a first and second port through which fluid can flow,

displacing at least a portion of said fluid sample from the intermediary region through the first port by inserting a second fluid into the intermediary region through the second port using the first pump, the first port being in fluid communication with the diluter so that the at least a portion of said fluid sample is displaced into the diluter from the intermediary region.

52. A method according to claim 51, further comprising;

disposing an internal standard into the sample, said internal standard comprising a known concentration of a predetermined substance, and

determining the factor by which the sample is diluted by comparing the detected concentration of the internal standard with the known concentration of the internal standard in the undiluted sample.

53. A method according to claim 52, wherein a second internal standard comprising a known concentration of a second predetermined substance is disposed in the sample and the diluent at the same second concentration levels.

54. A method according to claim 52, further comprising;

determining the dilution factor from the amount of the first internal standard detected by the analyser,

determining a correction factor by comparing the determined dilution factor with an expected dilution factor, and

using the correction factor to correct analyser data.

55. Apparatus according to claim 1, wherein the sample and/or the diluent contain an internal standard which comprises a predetermined amount of a known substance, and

a dilution factor by which the sample is diluted is calculable by comparing the detected amount of said internal standard by the analyser with the amount of internal standard in the sample or diluent.